CHAPTER 5

Planning for Trails and OHV Recreation

*"We abuse the land because we regard it as a commodity belonging to us.
When we see the land as a community to which we belong, we may begin
to use it with love and respect."* Aldo Leopold, A Sand County Almanac, 1949

Impacts from recreational trail use–both motorized and non-motorized–has not been a high priority concern for many managers over the past few decades, as use was relatively low and spread out. In 1940, Arizona's population reached one half million people (approximately 4 people per square mile). In 1970, there were 1.8 million people living in Arizona (approximately 16 people per square mile) compared with 6.6 million people in 2008 (approximately 58 people per square mile), a 273% change. Today, with this rapid and continual increase in population growth, more people are 'hitting' the trails on a regular basis and both managers and the public have expressed concern about the impacts to trails and OHV routes such as increased litter and trash, vandalism, ruts, mud holes, trampled vegetation, disturbed wildlife, invasive species and a proliferation of "social" trails.

Most parks and natural resource agencies are charged with a dual mission: to protect natural resources for future generations, and to provide for appropriate public enjoyment of these resources. Managers evaluate and define standards of quality that both safeguard the natural resources and provide a positive visitor experience—a daunting task in most cases.

There have been a number of studies completed that document or analyze trail impacts, how severe the impacts are, and which trail activity has the greater impact. Some studies counter the findings of previous studies, causing confusion and distrust of either result. The clear conclusion is, like any human outdoor recreation activity, building and using recreational trails and motorized routes result in some type of environmental impact.

A certain amount of impact from any trail building or recreational use is to be expected; the degree and extent of *acceptable* impact is a site specific issue.

Photo: Whether building a trail with hand tools or mechanized equipment, a certain amount of impact is unavoidable. The key is to plan for minimal impact and sustainability.

There are also social issues to consider in this debate. What a person prefers in their outdoor recreation experience, the environment they choose to be in, and the impacts they notice within this experience, are based on visitor perception.

A factor that is becoming increasingly important in trail and route management, is acknowledgement that a significant segment of motorized recreation users need specialized areas that allow them to do jumps, banked turns, race over rough terrain and crawl over huge boulders.

Without designated areas managed for these activities, motorized recreation users continue to recreate in unplanned, unsustainable route systems with no active management, resulting in environmental and social impacts.

Potential Impacts of Trails and Routes

Trails are generally regarded as an essential facility in recreation areas, providing access to remote areas, offering recreational opportunities, and protecting resources by concentrating visitor use impacts on resistant tread surfaces. Much ecological change assessed on trails is associated with their initial construction and is considered unavoidable by many (Birchard & Proudman 2000). Site planning that incorporates environmental and cultural concerns and implementation of proper, sustainable trail design can reduce construction impacts.

The type and extent of trail impacts are influenced by use-related and environmental factors, both of which may be modified through management actions. Use-related factors include type of use, amount of use and user behavior; environmental factors include attributes such as vegetation and soil type, topography and climate.

The principal challenge for trail providers is to prevent post-construction degradation from both recreational use and natural processes such as rainfall and water runoff. (Aust, Marion, & Kyle 2005)

Unsurfaced trail treads are susceptible to a variety of trail impacts. Common impacts include vegetation loss and compositional changes, soil compaction, erosion, and muddiness, exposure of plant roots, trail widening, and the proliferation of visitor-created side trails (Hammitt & Cole 1998; Leung & Marion 1996; Tyser & Worley 1992).

One element that is often overlooked when planning for and managing trail use is protection of *biological soil crusts*. These crusts are living communities of cyanobacteria (dominated by blue-green algae), micro-fungi, lichens, mosses,

Photo: Soil erosion and damage to vegetation are major trail use problems in the Southwest.

liverworts, and microorganisms that colonize the surface of bare soil (concentrated in the top 1/8" of soil) and hold the soil in place, protecting the underlying sediments from erosion. Living crusts are found all over the world, from deserts to tundra. These mats of living material cover virtually all spaces not occupied by green plants.

In Arizona the soils of our desert ecosystems are especially fragile and play an important role in the dynamics of desert plant communities. Soil disturbance does not 'disappear' with the next rain. The soil damage caused by breaking the "desert crust", known as cryptobiotic crust, can remain for centuries in low rainfall environments. Crusts retain water and increase soil fertility, and enable the land to recover more quickly after a fire. They are extremely susceptible to destruction by crushing or trampling.

Areas stripped of these crusts are vulnerable to erosion, flooding, deflation, dust storms, invasive species that thrive on disturbed soil, and/or chemical impoverishment due to loss of organic material and precipitation of minerals. Hikers, horseback riders, mountain bikers and OHVers who venture off established trails, whether in a desert, a woodland, or tundra environment, can damage these living crusts. (Moore 2007)

Soil erosion exposes rocks and plant roots, creating a rutted and uneven tread surface. Erosion can also be self-perpetuating when treads erode below the surrounding soil level, preventing the diversion of water from the tread. Eroded soils may find their way into water bodies, increasing water turbidity and sedimentation impacts to aquatic organisms (Fritz 1993).

Photo: Shoring up the hill side of a trail can reduce soil erosion and water runoff onto the trail.

Similarly, excessive muddiness renders trails less usable and aggravates tread widening and associated vegetation loss as visitors seek to circumvent mud-holes and wet soils (Marion 1994).

Trail widening and creation of parallel treads and side-trails unnecessarily increase the area of land disturbed by trails (Liddle & Greig-Smith 1975).

Table 51. Different forms of trail resource impact and their ecological and social effects

Form of Impact	Ecological Effects	Social Effects
Soil Erosion	Soil and nutrient loss, water turbidity and sedimentation, alteration of water runoff	Increased travel difficulty, degraded aesthetics, safety
Exposed Roots	Root damage, reduced tree health, intolerance to drought	Degraded aesthetics, safety
Secondary Treads	Vegetation loss, exposed soil	Degraded aesthetics
Wet Soil	Prone to soil puddling, increased water runoff	Increased travel difficulty, degraded aesthetics
Running Water	Accelerated erosion rates	Increased travel difficulty
Widening	Vegetation loss, soil exposure	Degraded aesthetics
Visitor-Created Trails	Vegetation loss, wildlife habitat fragmentation	Evidence of human disturbance, degraded aesthetics

Source: (Aust, Marion, & Kyle, 2005; pg. 8)

Trails, and the presence of visitors, can also impact wildlife, fragment wildlife habitat, and cause avoidance behavior in some animals and attraction behavior in others seeking to obtain human food (Hellmund 1998; Knight & Cole 1991). While most impacts are limited to a linear disturbance corridor, some impacts, such as alterations in surface water flow, introduction of invasive plants, and disturbance of wildlife, can extend considerably further into natural landscapes (Kasworm & Monley 1990; Tyser & Worley 1992). Even localized disturbance can harm rare or endangered species or damage sensitive resources, particularly in environments with slow recovery rates, such as deserts.

Impacts such as severe soil erosion and exposed roots are visually offensive and can degrade the aesthetics and functional value of recreational settings. Recent studies have found that resource impacts are noticed by visitors and that they can degrade the quality of recreation experiences (Roggenbuck *et al.* 1993; Vaske *et al.* 1993).

Photo: Erosion can cause deep ruts that may limit use.

Deep ruts and excessive muddiness on trails and routes increase the difficulty of travel and threaten visitor safety. From a managerial perspective, excessive trail-related impacts to vegetation, soil, wildlife or water quality can represent an unacceptable departure from natural conditions and processes. Impacts also result in substantial costs for the maintenance and rehabilitation of trails and operation of visitor management programs. (Aust, Marion, & Kyle 2005)

Photo: Proper trail design can help keep water off and people on the trails.

Sustainable Trails

Trail design and management are much larger factors in environmental degradation than the type or amount of use. Many studies have demonstrated that poorly designed or located trails are the biggest cause of trail impacts. A sustainable trail that is properly designed, constructed, and maintained can support trail uses with minimal maintenance or degradation. Well-designed and managed trails encourage the public to get out and enjoy natural settings without harming ecosystems.

The most effective way to minimize the environmental effects of trail recreation is to build environmentally sustainable trails. The goal of sustainable trail building is get the water off the trail and keep users on it. (IMBA 2006; Abell 2008)

A Sustainable Trail:

Protects the environment

Meets the needs of its users

Requires little maintenance

Minimizes conflict between different user groups

Essential Elements of Sustainable Trails:

1. Trail location: Sidehill trails are best

2. Sustainable trail alignment: Avoid the fall line

3. Half rule: Guides trail alignment; keep the grade of the trail less than half the grade of the sideslope, to keep water from diverting down the tread

4. Sustainable grade: Follow the ten percent average guideline

5. Maximum sustainable trail grade: trail alignment, half rule soil type, annual rainfall, vegetation, grade reversals, type of users, number of users, difficulty level

6. Grade reversals: Unbeatable drainage

7. Outslope: Ensuring sheet flow

8. Adapt trail design to soil texture

9. Minimize user-caused soil displacement

10. Prevent user-created trails

11. Maintenance and monitoring

(IMBA 2006; Abell 2008)

General Design Guidelines: Ideally, a site assessment should be completed before major investments in improvements are made. At a minimum, an initial site assessment should include a broad survey to obtain basic information on geology, geomorphology, watershed condition, wildlife habitats, cultural sites, and fluvial geomorphology. This should be followed by a detailed soil survey to provide a framework for developing logical trail systems. Knowledge of soil types is important in sustainable trail design, especially in desert settings. Finally, site-specific information should be collected on the current condition of the area, particularly surface soil condition and vegetative cover. The compaction of soils decreases soil pore space and water infiltration, which in turn increases water runoff and soil erosion, and plant germination and growth (Cole 1982; Cole 1991). Vegetation can be trampled affecting plant health, abundance, and composition, as well as habitats of smaller species of animals.

After trail development, adopt and implement a monitoring plan that helps detect problems with the design or use of the trails. Monitoring need not be expensive or time-consuming, but should be consistent. Monitoring should be used as an active management tool to determine if the long-term goals for the area are being achieved, and if not, changes should be made in management parameters.

Good trail design incorporates sustainable design and best management practices. Assess the need and demand for trail resources in a given area. Consider placing emphasis on developing sustainable recreation opportunities for those trail activities that are under served.

For more ideas about minimizing impacts on the environment or on other visitors, review *Leave No Trace* www.lnt.org or Tread Lightly! www.treadlightly.org principles.

Invasive Species—What are they, How do they get around, and Trail Use
By Joanne Roberts, Resource Ecologist, Arizona State Parks

Background: In today's modern society, transport, trade, and travel are global in nature, rapid, and massive in volume. Along with the international connectivity comes a growing threat of invasive species. The problems associated with non-native plants and animals, or invasive species, are a serious issue for Arizona. In recent years the introduction of invasive species has increased dramatically, representing a significant threat to both the economic and ecologic health of Arizona's natural heritage.

Photos: Buffelgrass is an invasive species that aggressively dominates desert ecosystems and carpets the ground, providing a continuous source of fuel for wildfires. Unlike Buffelgrass, native species are not adapted to fire and many are killed off.

Maintaining natural systems are important for ecologic and economic reasons. These natural areas filter ground water, cleanse the air and provide habitat for wildlife. They also increase property values for residents, improve sales at local businesses, lower health costs, and result in increased tax revenues for government.

Defining an Invasive Species and Pathways: Though many definitions for invasive species and pathways exist, these terms are defined as they relate to Arizona's Invasive Species Management Plan (AISMP 2008) and the National Invasive Species Council (NISC). It is recognized that not all non-native species are invasive and that some native species can act in an invasive manner. The NISC ensures Federal cooperation and coordination and the ASIMP sets State guidelines for a coordinated, multi-stakeholder approach to invasive species management.

> *"An invasive species is a non-native plant, animal, or other organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human health."*

Although many non-native species were introduced intentionally for a variety of reasons ranging from social demands for new or different pet species, erosion control, landscaping, crops for food, and management of pests; other species have hitchhiked on commercial transports, on pets, humans, livestock, automobiles and boats. These are all pathways and are defined as, *"the means by which species are transported from one location to another"*. There are natural pathways that include wind, currents, and other forms of dispersal in which a specific species has developed morphological and behavioral characteristics to employ. Man-made pathways are those pathways that are enhanced or created by human activity.

More simply stated, invasive species have and continue to be intentionally and/or unintentionally introduced and can cause harm to Arizona's native species and humans.

<u>Trails as a Pathway for Invasive Species</u>:
Regardless of type of trail use (e.g. equestrian, hiking, biking, motorized, boating), trails are corridors, or pathways, for invasive species. Concerns about spreading invasive species should be recognized when developing, maintaining or using trails. Moving soil from one location to another, non-native seed deposited by horses and livestock, seeds embedded in bike or ATV tires, snail, mussel and plant hitchhikers from waterway to waterway, bait dumping, and many other pathways play a tremendous role in invasive species movement and are tied to use of aquatic and terrestrial trails.

Photo: Trails are pathways for invasive species, such as non-native seed deposited by horses and packstock, seeds embedded in boots or bike and ATV tires. Sonoita Creek State Natural Area.

Being aware that you, as a trail user, are a potential vector is the first step in assisting resource managers in combating invasive species in Arizona. Link to the Governor's website for Arizona Invasive Species, http://www.governor.state.az.us/ais/ or http://hermes.freac.fsu.edu/imi/az/ for more information.

Table 52. Land Managers Perceptions of Non-motorized and Motorized Trail Use Increasing Invasive Species

Invasive Species	% Not a Problem		% Slight Problem		% Moderate Problem		% Serious Problem	
	Non Motor	Motor	Non Motor	Motor	Non Motor	Motor	Non Motor	Motor
State Agencies	24.1	14.3	41.4	33.3	24.1	38.1	10.3	14.3
Federal Agencies	22.1	8.9	32.4	23.2	29.4	37.5	16.2	30.4
Cities/Counties	38.8	25.0	36.7	35.0	12.2	10.0	12.2	30.0

Planning Trails and Routes with Wildlife in Mind

This section introduces a few of the key wildlife related factors and questions to consider when planning a trail or OHV route. How can trails best be planned and managed to recognize the needs and sensitivities of wildlife and the environment? What impacts do trail development and use have on wildlife and watersheds? What can we do to minimize these impacts? Trail planners and builders should balance the benefits of creating trails and being stewards of nature, especially wildlife. The Arizona Game and Fish Department produced a user friendly 2009 guide to community planning with wildlife in mind, *Wildlife Friendly Guidelines: Community and Project Planning* (www.azgfd.gov/pdfs/w_c/WildlifeFriendlyDevelopment.pdf). The section on trails is excerpted here.

Nature Hiking/Biking Trails within Development and Connection with Regional Trails
There are many benefits of trails and greenways. They make our communities more livable, replace greenhouse-gas emitting modes of transportation, improve the economy through tourism and civic improvement, preserve and restore open space, and provide opportunities for physical

activity to improve fitness and mental health. They can also provide wildlife-viewing opportunities and reduce pressure on expanding vehicular transportation systems that have impacts to wildlife and their habitats.

Economic and Community Values
Trail systems help preserve a distinctive and slower paced or "rural" atmosphere. Trails and open spaces can offer developers and property owners higher property values. Some communities report that their trails attract recreational tourist dollars and become opportunities for business development such as outdoor stores, equestrian centers, and bed and breakfast places along extended routes. Around shopping areas or business parks, trails can enhance the way that space is used, integrating recreation and respite opportunities, inviting moments of pause and renewal amid the hectic pace of such urban places.

Recreational trails can be a useful feature incorporated into the urban-wildland interface. A recreational trail along an urban boundary provides public access to open space while minimizing the adverse effects of this access on sensitive biological resources that might occur nearby.

Recreational trails can easily be combined with other interface elements such as wildlife exclusion fencing, drainage controls, and firebreaks. Interpretive signs placed along recreational trails can inform the public about the adjacent preserve or natural area and create a sense of ownership and stewardship among local residents. These residents can then serve as informal patrols for the project developer or Homeowner's Association to help ensure that resources are protected. Trails through particularly sensitive areas can be designed to minimize impacts through the use of boardwalks, bridges or raised platforms.

Buffering vegetation can be effectively used adjacent to trails to serve as a physical and visual barrier between the trail and the preserve or natural area. For example, native drought-tolerant and fire-resistant shrubs could be planted between a trail and a low barrier fence to discourage entry into sensitive areas alongside trails.

Trails provide convenient access for people to enjoy viewing wildlife, experience local wildlife habitats, and encourage stewardship for the local environment that might otherwise be lost. Good trails reduce environmental degradation, promoting care and appreciation instead. Urban trails are increasingly convenient and provide for a much larger base of community participation than trails located in wildlands. Through signage and educational interpretation, trails are a device for expanding awareness of environmental values, wildlife, and geologic features. Urban trails are linear parks - taking parks to people in ways that enhance a sense of community participation and real connection to nature.

Arizona Wildlife Linkages Assessment
Recognition of the importance of wildlife connectivity as a response to habitat fragmentation from roads, developments, and other factors within Arizona has been increasing thanks to the efforts of the Arizona Wildlife Linkages Workgroup and their development of the "Arizona Wildlife Linkages Assessment" in 2006 (http://www.azdot.gov/Highways/OES/AZ–Wildlife_Linkages/index.asp). This effort identified 152 potential wildlife linkage zones across the state. Sixteen of these zones have been further refined by Dr. Paul Beier and his Corridor Design Team from Northern Arizona University and are referred to as "Arizona Missing

Linkages" – http://www.corridordesign.org/arizona/. (See Appendix F for more information regarding Arizona's Wildlife Linkages Assessment & Arizona Missing Linkages). Efforts are currently underway to further refine the 2006 Assessment report with identification and refinement of additional wildlife corridors at the county level, with Maricopa and Coconino stakeholder workshops already completed.

As with other development projects, trail systems (both motorized and non-motorized) can create challenges for maintaining wildlife connectivity. When new trails or maintenance to existing trails are proposed, land managers should consider their impact on wildlife within and around the project area by preserving habitat requirements (i.e., food resources, breeding areas, cover, travel corridors, etc.) as much as possible and thereby enable wildlife connectivity. For more information on wildlife corridors or Arizona's wildlife, please contact the Arizona Game and Fish Department at 602-942-3000.

Colorado State Parks also has an excellent 1998 publication: *Planning Trails with Wildlife in Mind (*http://atfiles.org/files/pdf/Primer.PDF). A few excerpts can be found here.

Some overall observations regarding trails and wildlife

- When planned with wildlife in mind, trails can be effective management tools that help reduce the impacts of people on wildlife.
- A trail is more than a thin line traversing the landscape. To respect wildlife, a trail must be planned in conjunction with its zone of influence.
- In building a trail, we may choose to impact wildlife and habitats, but we should do so with an understanding of the implications.
- In many cases, scientific knowledge alone can't determine whether wildlife impacts are great enough to preclude a trail. The decision also should be based on community values, including the benefits the trail will offer the public.
- Wildlife don't necessarily see the landscape the way we do. What may appear to a person to be a minor change may be perceived quite differently by wildlife.
- If we learn to see the landscape more as wildlife do, we can find trail alignments that will have less impact on their surroundings.

- Understanding both the existing and potential impacts of a trail to wildlife can help set more realistic goals for a trail project.
- Native biological diversity is much more than a count of the species found in an area. Instead, it is a broader concept that includes all facets of our natural living heritage.
- The best strategy in planning trails is always to avoid impacts to wildlife. The next best is to minimize the impacts. The last resort is to mitigate for impacts.
- Plan and manage a trail in ways that help make users more predictable to wildlife so they can acclimate to people. (Colorado State Parks and Hellmund Associates 1998)

Regional Trail Planning In Arizona

Arizona has shown active involvement in trail planning in both local and regional levels for several decades. Communities throughout Arizona have worked at both independent and partnership related trail planning. As much as we celebrate the work that has been completed, there is more to be done to meet future needs and reduce development impacts to trails.

A new aspect in trail planning came in 1998, when the Arizona Legislature passed the Growing Smarter Act. This Act clarified and strengthened planning elements in the required plans of municipalities and counties and added four new elements, namely: Open Space, Growth Areas, Environmental Planning, and Cost of Development. In 2000, the Legislature passed Growing Smarter Plus to further enhance land use planning statutes in Arizona. Many cities and counties have now included trails in the Open Space element of their plans.
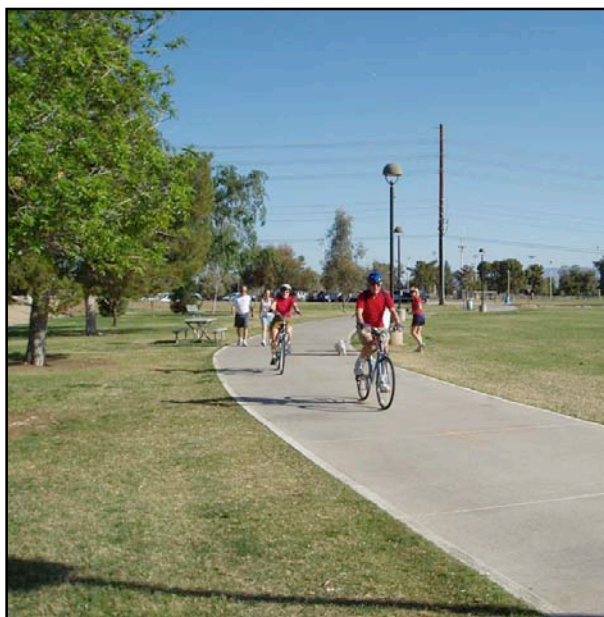
Photo: Connections between urban and rural trails and pathways need to be considered when planning regionally. Photo courtesy of ADOT Transportation Enhancement Program.

Planning is only part of the process. The *implementation* of plans such as acquiring land and access easements, and building and maintaining trails is the next critical step. Many existing trail plans have challenges of staffing and funding levels that may prohibit their implementation.

Table 53. Sample Listing of Trail Plans in Arizona

Sample Listing of Trail Plans in Arizona	
for full listing and links to the trails plans visit http://azstateparks.com/trails/trail_construction.html	
City and Town Trail Plans	
Cave Creek Trails Plan	Gilbert Trails Plan
Payson Area Trails System	Phoenix Trails Plan
Scottsdale Trails Plan	Show Low Trails Plan
Queen Creek Trails Plan	
County Trail Plans	
Maricopa County Trails Plan	Pima County Trails Plan
Pinal County Trails Plan	Yavapai County Trails Plan
Parks Trail Plans	
San Tan Park Trails Plan	Saguaro National Park Trails Plan
County General Plans with Recreation or Trail Language	
Coconino County: General Plan: Parks and Recreation Portion	Mohave County General Plan
Navajo County General Plan	Yuma County General Plan

City and Town Master Plans with Trails Components	
Buckeye General Plan	Peoria General Plan
Safford General Plan	Tucson General Plan
Regional Master Plans with Trails Components	
Desert Hills Plan Resource	Sonoran Desert Plan-Pima County
Verde Valley Regional Land Use Plan	West Valley River Recreation Corridor Plan
Prescott Circle Trail	Flagstaff Urban Trails System

Trails plans can vary greatly depending on the overall goal of the plan but there are common components of most trail plans. Below are two sample Table of Contents for either a basic trail plan or a more comprehensive trails plan.

A. BASIC TRAILS PLAN
      Table of Contents
      Introduction
            Vision and goals
      Trail System (could be a map only)
            Key existing trail system and trails
            Potential Trails
      Implementation Strategies (construction and maintenance)
            Funding Sources
            Potential volunteers
      Trail Standards and Guidelines

B. COMPREHENSIVE TRAILS PLAN
      Potential Table of Contents
      Executive Summary
      Introduction
            Purpose
            Scope
            Goals and Benefits
      Planning Process
            Advisory Committees
            Community Involvement
            Related Planning with Other Management Plans
      Background and Overview
            General description of area
            Cultural and Natural Resource Analysis
                  (Historic, vegetation, wildlife, special status)
            Land Ownership
      Trail System
            Key existing trail system and trails (Motorized and/or Non-motorized)
            Trail Usage
            Potential Trails
                  Roadways
                  Washes
                  Waterways
                  Railways
                  Utility Lines
            Proposed Trails
                  Proposed Trailheads
            Regional/State Trail Linkage

Signage and Interpretation
Implementation Strategies
    Funding Sources
        Federal, state, local and other
    Partnerships and Fundraising
    Developers/businesses, landowners, other municipalities
Management
    Volunteers
    Staffing
    Enforcement
    Emergency services
Marketing and Education
    User education
    Attracting new users
    Educational materials
    Maps
Guidelines, Policies, Ordinances
    Trail Guidelines
        Building standards, trail materials and structures
        ADA
        Maintenance standards
        Safety/liability issues
    Policies
        Private access to public trails
        Trail monitoring and maintenance
        Trail patrol
        Access to park and recreation facilities
        Prioritizing facility development
        Acquisition and development program
        Protection, operation and maintenance
        Use of volunteer programs
        Trail system coordination
        Role of federal, state and local government
        Role of the private sector
        Cooperative agreement policy
        Emergency procedures
        Law enforcement
        Waiver of liability
        Records and documentation
    Sample Ordinances

Off-Highway Vehicle Planning

OHV use can be a safe, enjoyable, low impact activity when approached within the confines of the law, on established routes, trails, or use areas, and with proper management, and common sense. The opposite is true when OHV recreation is approached with disregard for the environment, and a lack of respect for other recreationists or personal safety. To help promote responsible OHV use and to deter unsafe OHV use, laws and guidelines have been created which outline safe, legal, and common sense approaches to OHV activities.

The cornerstone of OHV management is the four Es: Engineering, Enforcement, Education, and Evaluation. Each of these elements is

Photo: Saffel Canyon OHV Area in northeast Arizona is managed by the Apache-Sitgreaves National Forest.

essential to being able to provide sustainable OHV use in the state of Arizona. Provided here is a focus on the "engineering" aspect of motorized trails–excerpts included in this section are courtesy of the National Off-Highway Vehicle Conservation Council (NOHVCC) and Tom M. Crimmins from the 2006 publication *Management Guidelines for OHV Recreation*.

The Case for Management: The first real focus on management of OHV use on public lands in the U.S. began in 1972 and again in 1977 when executive orders were signed by the President requiring agencies to identify "specific areas on public lands where use of off-road vehicles may be permitted and areas in which the use of off-road vehicles may not be permitted". Three classifications are applied:

• Open—areas that are open to cross-country travel
• Limited—Areas that have some restrictions or limitations on motorized vehicle use
• Closed—areas where motorized vehicle use is prohibited

In Arizona, many federal public lands were open or limited to "existing routes". Today, things are changing. There are too many people, too many machines, and too many traditional riding areas being closed to continue to ignore the fact that OHV activities, like all other recreational activities, must be managed. It is clear that OHV recreation is not a passing fad that will slowly lose its allure. We have areas where the resources are being impacted and most of these impacts can be traced to a lack of management.

The Bureau of Land Management is moving to a concept of "managed open areas". Cross country travel will still be allowed, but in much smaller areas.

Photo: Dozens of people turn out for an ATV event in the White Mountains. Photo courtesy of Mike Sipes.

In areas where active management is being applied, experience clearly shows that OHV use can be managed, resources protected, and the OHV enthusiast can have a satisfying recreational experience. What does it take to manage OHV use?

<u>User Needs and Desires</u>: Before any decision is made or action taken to provide OHV recreation opportunities, it is important to understand the full range of activities that may be desired.

- **Recreational trail riding** is best served by a series of interconnected loop trails that range in difficulty levels.

- **Non-competitive organized trail riding** can include both trail and road segments and can cover a variable course length.

- **Competitive Activities** may be in the form of an organized, sanctioned, insured and paid event where competitors are required to traverse a predetermined course with specific time constraints. These events may occur on the same trails available for recreational trail riding but can be in a more controlled environment.

- **Observed trials** are events where riders attempt to ride over logs, boulders, or other obstacles in a slow, controlled manner without the rider putting his foot down on the ground. These events require areas other than designated recreational trails.

Photo: Desert racing is especially popular with the younger crowd. Photo by Laurie Watts.

- **Motocross tracks** for practice and competition is a race held on a tight, turning, one-way course with a variety of natural terrain, man-made obstacles or jumps.

- **Hill climbs** for practice and competition where challengers start at the bottom of a long, steep hill and try to reach the top without crashing. This activity requires very specific terrain.

- **Mud bogs** for practice and competition is where a participant traverses through an area of water and mud. This activity can occur in natural terrain where runoff and impacts can be controlled or in a man-made area specifically designed to contain water and mud. Users need to be informed why this activity is acceptable under managed conditions but not acceptable in a general trail environment.

- **Obstacle courses** are usually held in a small area of natural or man-made features to test and enhance the participants' skills. Obstacles can be designed to replicate features encountered on trails or they may focus on specific riding skills.

- **Open areas** such as sand dunes, gravel pits, and other sites lend themselves to open cross-country riding. In addition, smaller areas may be incorporated into larger trail riding areas to meet the needs of some riders. Play areas are smaller, confined areas where use is not limited to trails.

- **Other areas** may include the use of an OHV to access hunting and fishing sites, big game retrieval, antler collecting, and wood gathering.

Photo: Hot Well Dunes, managed by BLM, attracts large numbers of sand dune enthusiasts.

OHV Engineering or Facility Design
The following are examples of problems and solutions identified in OHV management.

- Off-route use occurs: Determine why people are leaving trails. Is it because the trail is not challenging, too short, doesn't include a desired destination point, or the route is unclear or confusing? Add lengths of trail, barriers or signage that address the specific problem.

Photo: Route proliferation is a major problem in Arizona. Planning routes tailored for the user's desires can reduce off-route use. Talk to your users.

- Route proliferation: See off-route use above. Examine trail designation standards (open areas vs limited use) and make changes if needed.

- Speed: People travel too fast on the trails creating safety and resource problems. Keep trails narrow. Shorten sight distances with twists and turns or by using existing landscape and terrain. Avoid identifying one-way trails.

- Visitors create problems as they search for challenges: Provide opportunities for people to find a challenge in an appropriate manner. Maintain trails to provide challenges by leaving obstacles in trails or by building trails with higher levels of exposure. Play areas with challenging terrain may be one way to help satisfy this need.

- Sound: Vehicle noise disturbs neighbors, wildlife and other trail users. Locate routes in a manner that reduces sound transmission. Move trails from tops of ridges down the slope. When possible, locate trails away from interface areas where housing development is encroaching on recreation areas

Photo: Routes with challenging terrain are a high priority for OHV users. Consider this when planning maintenance or other repairs to routes.

- Wildlife disturbance: Where wildlife security is an issue, trails and routes can be located in a manner that provides increased screening, or realigned to divert use away from key wildlife areas. Trails could be located closer to existing road corridors to increase habitat effectiveness. Apply seasonal closures if trails are close to breeding, calving or nesting areas.

- Water quality: Construct or reconstruct routes with rolling dips, undulating trail design, or trail grade breaks. Avoid installing multiple waterbars. Locate trails to reduce stream crossings and harden where appropriate to reduce sediment delivery.

OHV Education

Most people want to do what is "right" but they may not know what is right for different situations. Education is a critical part of OHV management. Use websites, maps, brochures, trailhead kiosks, signs, on the ground ranger presence, and volunteer peer patrols to get your message across.

A basic premise is that educated riders are responsible riders, and responsible riders keep riding opportunities open and reduce impacts. Education should be stressed over citations. For those riders who know what is right and still violate rules and regulations, strict enforcement of the law is necessary, both in the field and in the courts.

Visitors need to know:

Photo: While providing a source of trail maps and information, steel kiosks have also reduced vandalism.

- What to expect during their visit, such as types of opportunities that exist, available trail experiences, other users they may encounter.

- What types of restrictions are in place such as vehicle types limited, seasonal closures, invasive species controls.

- What is unique about the area such as special features, species, cultural sites.

- What behaviors are appropriate.

- Where to go for specific information; contacts information.

- Why the rules exist—compliance will increase when riders understand the issues and rationale behind rules and restrictions.

Photo: Holding "meet & greet" events at OHV staging areas are a good way to reach users.

Arizona Open Space and Recreation Inventory

By Genevieve Johnson, Open Space Program Manager, and Laura Burnett, GIS Analyst, Arizona State Parks

Growth projections generated by the Maricopa Association of Governments (MAG) show areas expected to be developed by the year 2050 as "red dots." This scenario depicts Phoenix and Tucson merging together into one large megapolitan area named the Sun Corridor.

Figure 20. Growth Projections for Arizona from the Maricopa Association of Governments
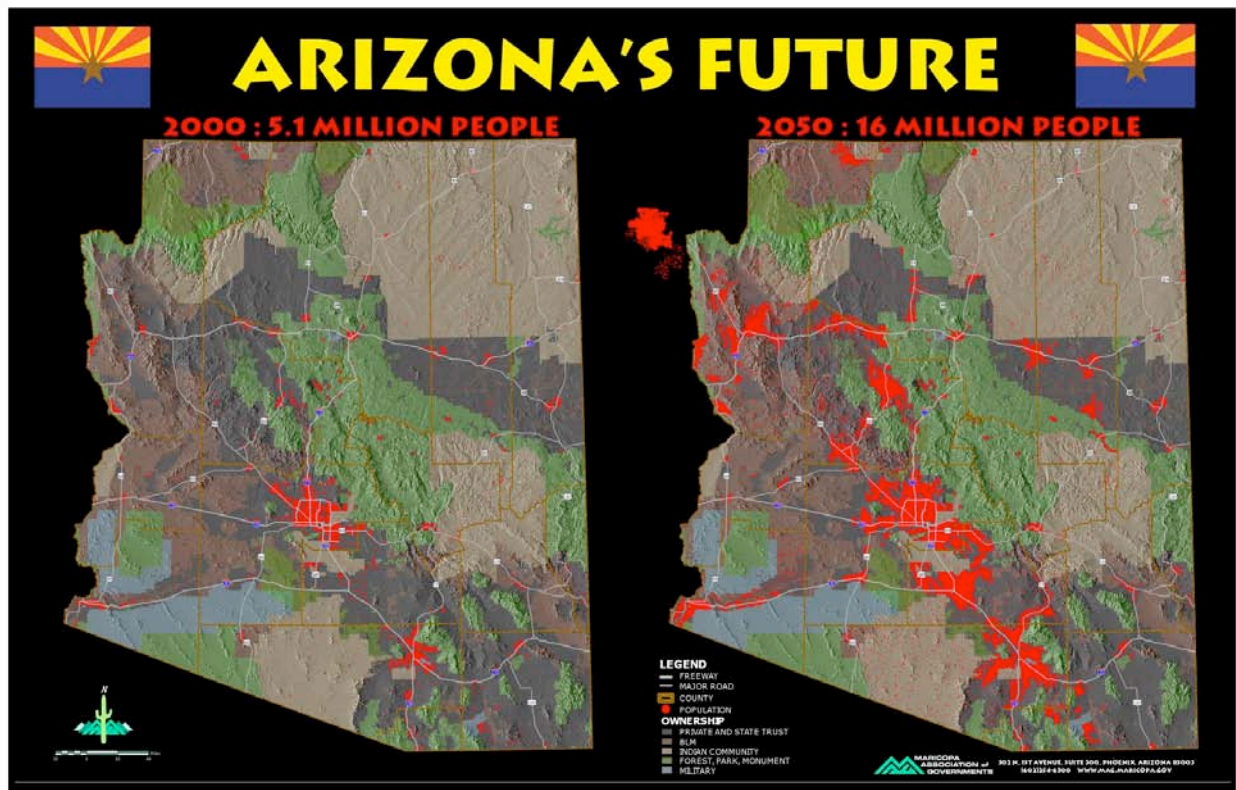
Note: The red areas are expected to be developed. The population projections have decreased since these maps were created, but revised estimates by DES still predict that Arizona's population will more than double by 2050, reaching 12.8 million people. Most growth will come from births, not in-migration.

In response to the MAG projections, Arizona State Parks began preliminary work in 2006 on open space data collection, modeling, and visualization. During the process of data collection and integration, staff found that data on open space, as well as natural, cultural, and recreation resources is scattered, difficult to find and interpret, and difficult to compile. The data is subject to a myriad of different data use agreements, accuracies, scales, and the processes by which they were created. Often it has to be digitized or created from tabular information and is lacking documentation about who, what, when, where, why, and how the data was created. While these assessments and existing data sets can provide a useful starting point for open space and recreational planning, collecting, compiling and dealing with data use agreements and compatibility issues between data sources are extremely time consuming.

It was further determined that additional data was needed at the statewide level to effectively plan for open spaces and recreational amenities as Arizona's population grows. Governor Janet

Napolitano's Growth Cabinet recommended that the State, "commission a comprehensive inventory of the natural (including wildlife habitat), cultural, historic, and recreational assets of Arizona to serve as a blueprint for promoting the valued resources that define Arizona." In response, a partnership (inventory team) was formed in 2006 between the Arizona Office of Tourism, Arizona Game and Fish Department, Arizona State Museum, and Arizona State Parks to complete these inventories, with the idea that the combination of the wildlife, cultural, and recreation inventories, together with existing assessments could enable planners at all levels to more easily identify opportunities for collaboration in planning and working to sustainably preserve a network of open spaces, parks, and wildlife corridors as Arizona continues to grow.
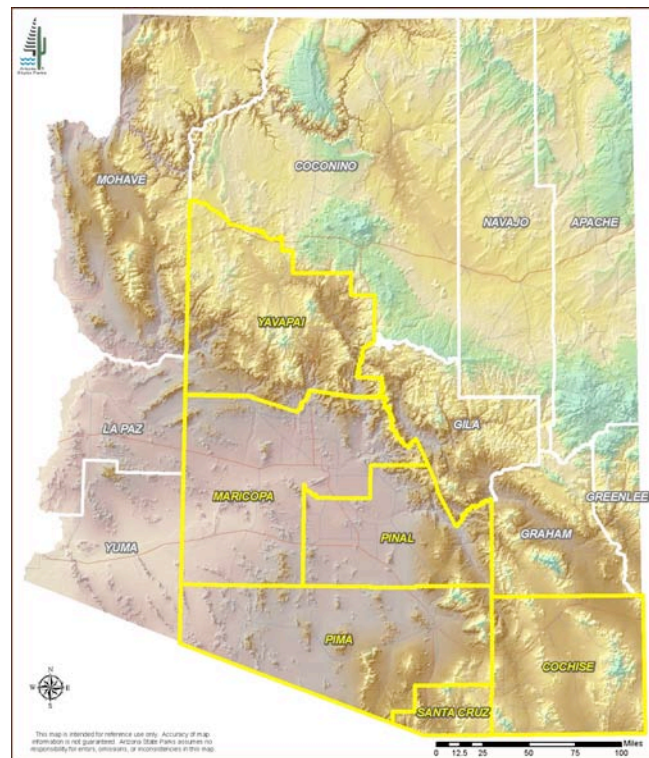
Recreation and Open Space Inventory
At the start of this project, comprehensive statewide spatial data on open space and recreational resources was virtually non-existent. Few multi-jurisdictional efforts have worked to create recreational resource data, with exception of efforts in Maricopa, Pima, and Yavapai counties. GIS data on parks, open spaces, trails and trailheads is often extremely difficult to find. For example, Arizona State Parks maintains a database of trails that have been accepted into the State Trail System, but up until this point, the database was not linked to spatial information. For trail users, finding information can be a challenge.

Inventory Overview
For the recreation and open space inventory, Arizona State Parks requested GIS data, maps, and/or any available information on existing or proposed parks, open space, trails, trailheads, and other recreational resources from every county and municipality in Arizona. We have also worked with other state and federal land management agencies to include these areas in the inventory.
Data compilation began with the Sun Corridor in FY 2008, and is currently ongoing for the remainder of the State. For this project, the Sun Corridor is defined as encompassing Yavapai, Maricopa, Pinal, Pima, Santa Cruz, and Cochise counties in their entirety (see Figure 21).

To date, 56 of 63 municipalities and counties within the Sun Corridor (88.9% response rate) and 29 of 42 municipalities and counties in the remainder of the state (69% response rate) have participated in this data collection process. Data from

Figure 21. The Sun Corridor, as defined for this project, is outlined in yellow.

municipalities, counties, and federal agencies are shown in the following maps. Both existing and potential future non-motorized trails by type are depicted for the state.

Figure 22. Existing Non-motorized Trails in Arizona

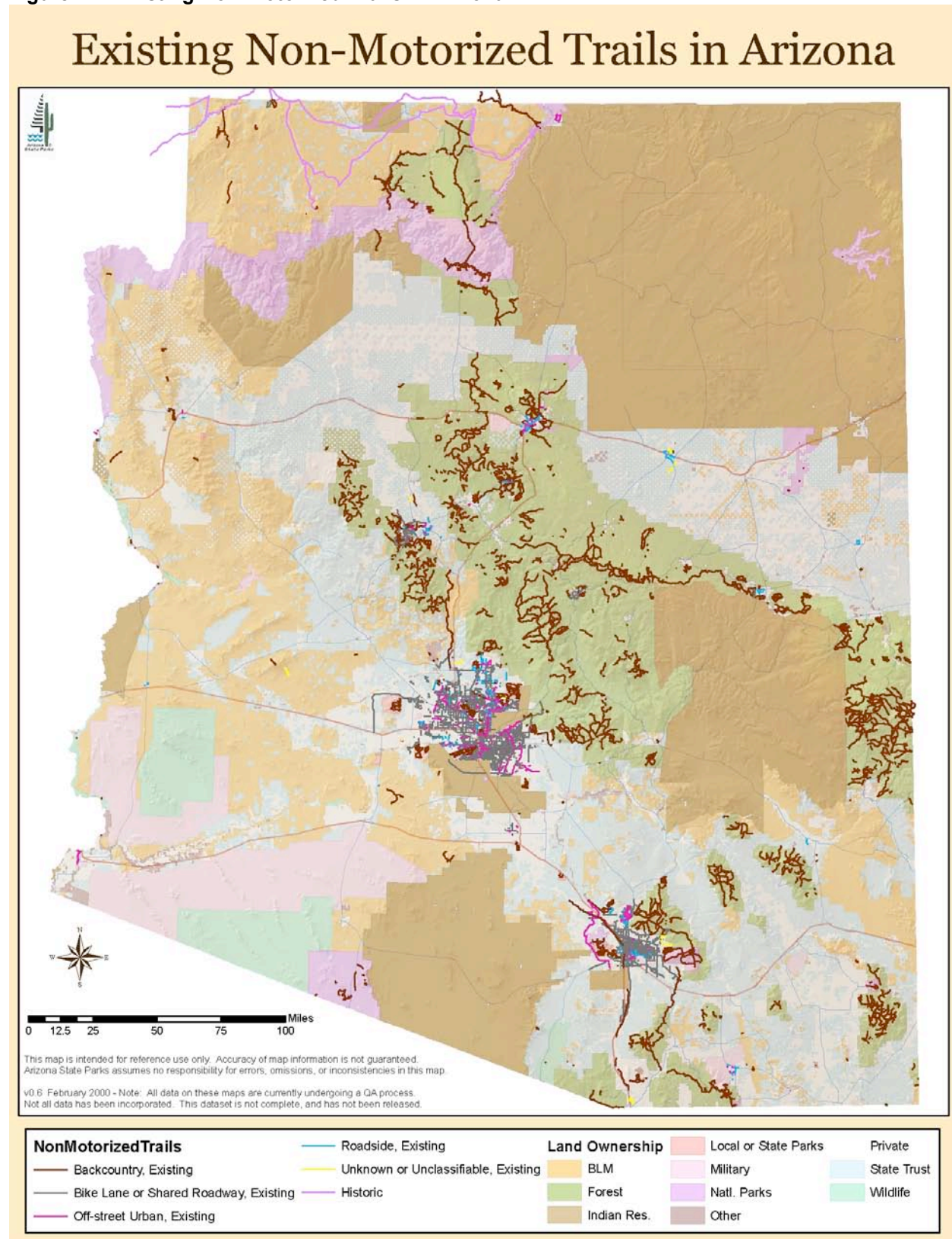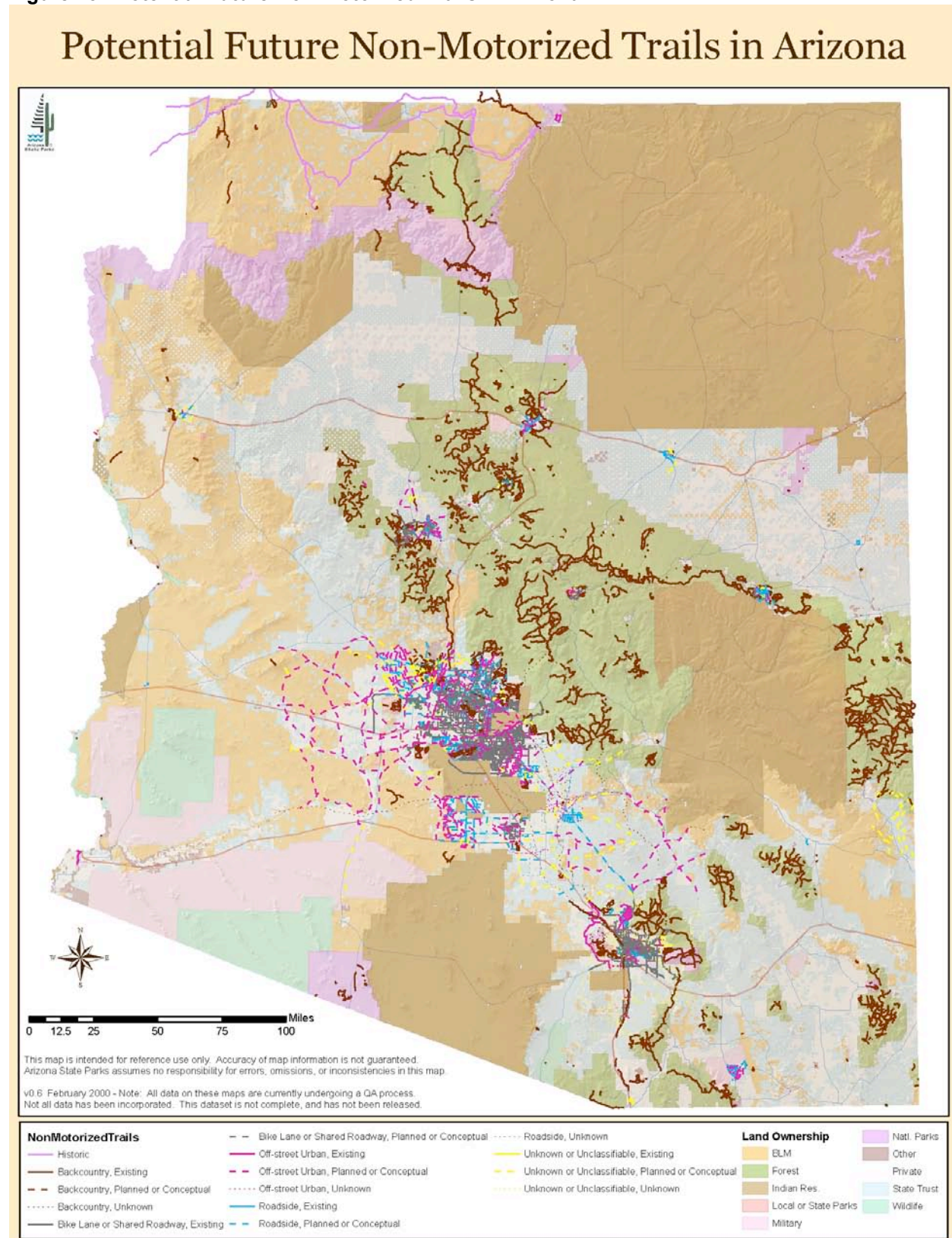Existing Non-Motorized Trails in Arizona

Figure 23. Potential Future Non-motorized Trails in Arizona

The data provided by the jurisdictions was compiled into a standardized geodatabase. For version 1.0 of the inventory, the inventory team focused on seven feature classes: existing parks, existing open space, proposed parks, proposed open space, golf courses, non-motorized trails, and trail access points (trailheads). Examples of the geodatabase structure (shown in Tables 54 and 55) list the attributes collected for the non-motorized trails and trail access point feature classes and provide a good starting point for municipalities beginning to collect geospatial data on trails and trailheads, as well as on parks and open spaces within their jurisdictions.

Table 54. Fields comprising the non-motorized trails feature class

Attributes	Field Name	Domain
Trail ID	TrailID	
Trail Name	TrailName	
Trail Number	TrailNum	
Segment Name	SegName	
Trail System	TrailSys	
Status	Status	Existing Planned Conceptual Unknown
Surface	Surface	Natural Pavement Both Unknown
Hiking	Hiking	Yes, No, Unknown, Portions
Equestrian	Equest	Yes, No, Unknown, Portions
Biking	Biking	Yes, No, Unknown, Portions
Skiing	Skiing	Yes, No, Unknown, Portions
OHV	OHV	Yes, No, Unknown, Portions
ADA	ADA	Yes, No, Unknown, Portions
Pets Allowed	Pets	Yes, No, Unknown, Portions
State Trail System	StateTrail	Yes, No, Unknown, Portions
Management Agency	MngAgency	
Management Unit	MngUnit	
Data Source	DataSource	
Maximum Elevation (Ft)	MaxElevFt	
Minimum Elevation (Ft)	MinElevFt	
Elevation Change (Ft)	ElevChngFt	
Length (miles)	LengthMi	
TrailType	TrailType	Backcountry Canal Roadside Urban Wash Flood Control Off-street Urban Utility Corridor Unknown Unclassifiable Bike Lane Shared Roadway
Website	Website	

Table 55. Fields comprising the access points feature class

Attributes	Field Name	Domain
Access ID	AccessID	
Access Name	AccessName	
Status	Status	Existing Planned Conceptual Unknown
Parking	Parking	Parking Lot Limited None Unknown
Drinking Water	DrnkWater	Yes, No, Unknown
Restrooms	Restrooms	Yes, No, Unknown
Horse Staging	HorseStage	Yes, No, Unknown
Visitor Center or Ranger Station	VCorRanger	Yes, No, Unknown
Campground	Campground	Yes, No, Unknown
Fees	Fees	Yes, No, Unknown
Management Agency	MngAgency	
Management Unit	MngUnit	
Data Source	DataSource	
Elevation (Ft)	ElevFt	
Website	Website	

For the non-motorized trails and trail access points/trailheads the inventory team chose attributes based in part on the data that has been collected in the past for trails within the State Trail System. The inventory team consulted with the State Trails Coordinator, and tried to keep the data dictionary short enough to be manageable. The team also reviewed the Federal Interagency Data Standards for trails, and tried to incorporate as many of the concepts as possible.

After discussions with various municipal, county, and federal staff, the team concluded that "trails" include backcountry trails, off-street urban trails, roadside trails, and also bike lanes and shared roadways. The team defined backcountry trails as including trails in a predominantly natural setting, such as within the National Forests, on BLM land, or within large parks. The off-street urban category includes trails that are located predominantly within urban areas, and includes trails along canals, washes, powerlines, in small parks, and in other non-roadside locations.

The roadside category includes trails that are located along the side of roads. For this inventory, in order to qualify as a roadside trail, the trail should be physically separated from the surface on which cars drive. A bike lane is defined by the American Association of State Highway and Transportation Officials (AASHTO), as "a portion of a roadway that has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists". Shared roadway is defined by AASHTO as "a roadway, which is open to both bicyclists and motor vehicle travel". This may be an existing roadway, street with wide curb lanes, or road with paved shoulders. Shared roadways may also be used by pedestrians and others. The shared

roadway category includes the "bike route" category used by Maricopa Association of Governments. A status field in the non-motorized trails and access points feature classes denotes whether the features are existing, planned, or conceptual.

The trails access points feature class includes developed trailheads, as well as some undeveloped trail access points. Very few organizations from which we received trails data provided trailhead or trail access point data. Any trailhead information provided was included if possible. For trails within the State Trail System, information from the Arizona State Trails Guide was used. Additionally, trails categorized as backcountry were not included unless at least one trailhead or access point could be identified.

Many of the access points were digitized based on aerial photos, trail maps, topographic maps, site visits, and/or information from agency websites. The team did not digitize access points for off-street urban trails, roadside trails, bike lanes, or share roadway. It was assumed that trails within these categories are generally more easily accessible along their entire length. This assumption is flawed, but was necessary due to time, staffing and budget constraints. The inventories will need to be continually maintained. Arizona State Parks is the logical agency to continue maintenance of statewide information on parks, trails, and open space.

**Potential Uses of the Open Space and Recreation Inventory**
 "Understanding the proximity of people's homes to parks is an important aspect of recreation planning. While people may travel considerable distances to their "favorite" area, most people spend the majority of their leisure time, such as the start or end of a work day or a few hours on the weekend, at sites close to home. Distance becomes a key factor for these 'quick' trips on whether or not to visit a local park, trail or recreation area." (ASP SCORP 2007)

The Statewide Open Space and Recreation Inventory can be a useful tool in helping regional trail planning efforts. One potential use of the inventory is to conduct a "gap" analysis to determine where areas exist that might have less access to trails and other recreational amenities. Assessing access to such amenities can provide communities with a comprehensive, quantitative approach to planning for additional trail and recreational needs and opportunities.

Trails Inventory
The inventory also allows one to look at the miles of trail types that currently exist or are planned for the future. Figure 22 shows that the majority of the state's existing trails are categorized as backcountry, but in response to growing urban populations, many communities are also planning for future off-street urban trails. This information can be further broken down by county or city and provides a benchmark of the state's planning status for non-motorized trails.

As the data is updated, we can track the mileage of trails actually built, as well as assess the need for additional trails over time. This process is made easier for municipalities and other trail planning and building organizations because spatial trails data is now compiled into one standardized, comprehensive database.

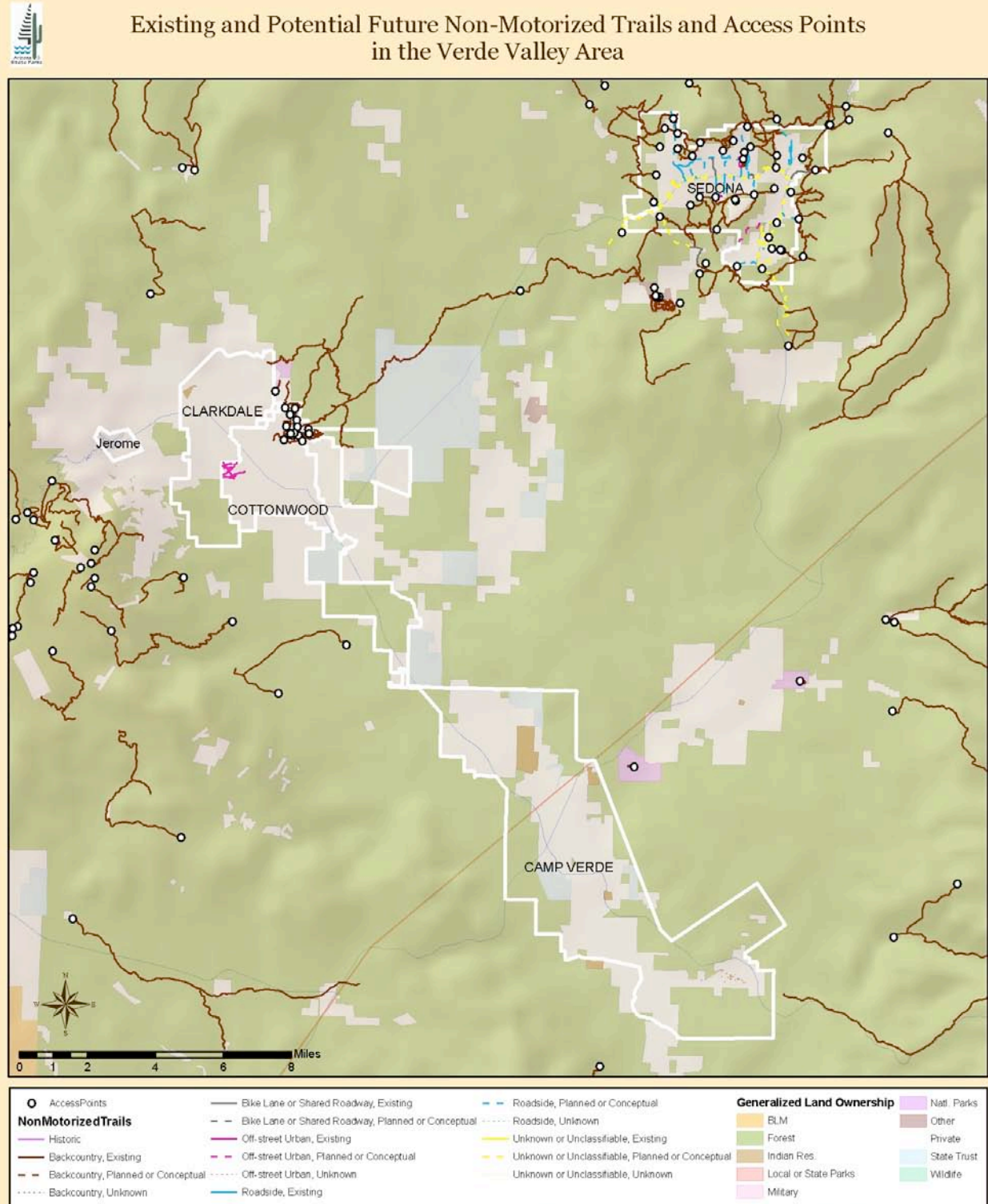**Figure 24. Non-motorized Trails Inventory**

Non-Motorized Trails Inventory as of February 2009
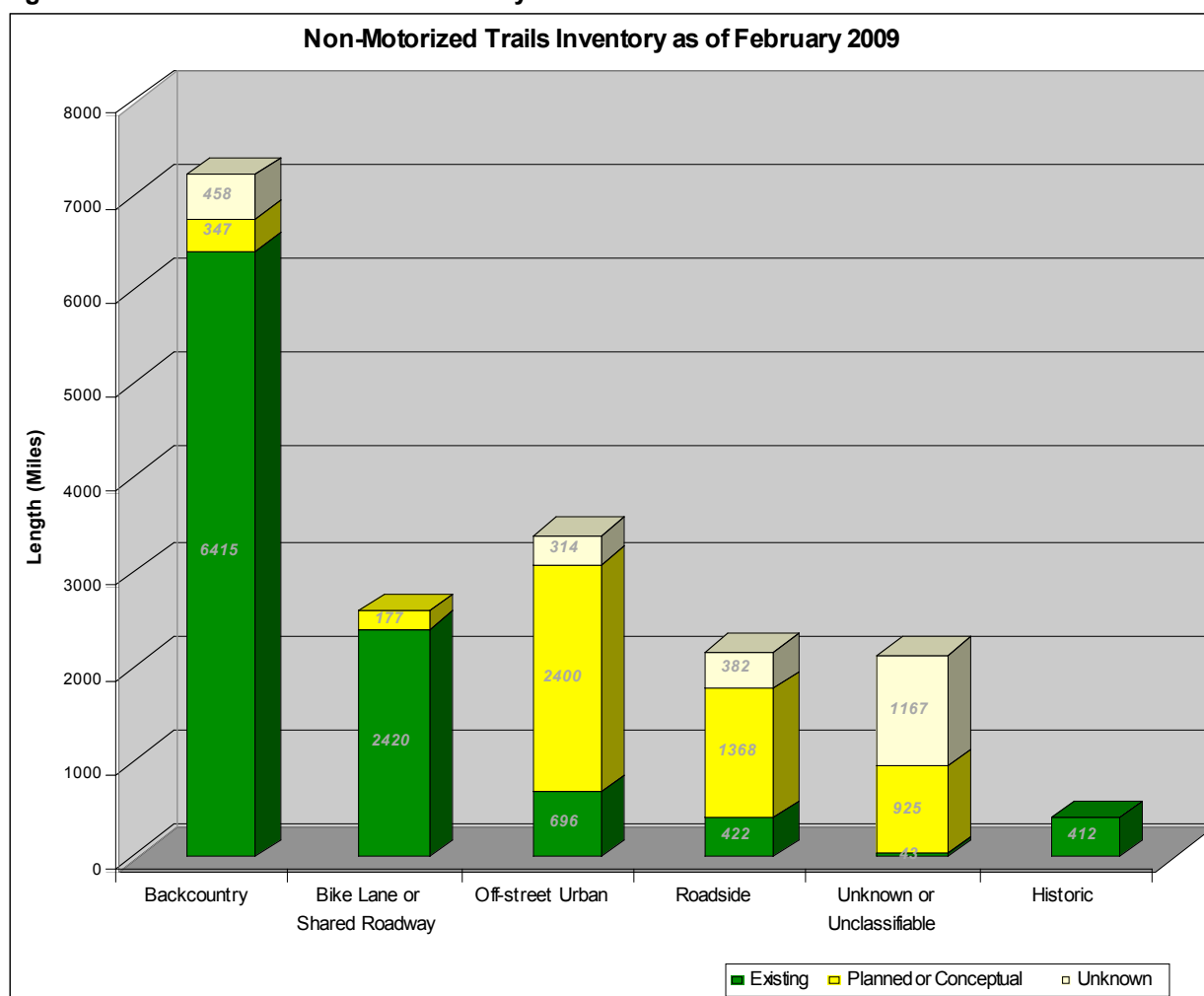
Trails Connect Communities to Each Other and to Public Lands

Another example of how to use the database is shown in Figure 25. This map shows that access to U.S. Forest Service trails from Sedona is relatively high and evenly spaced throughout the community. In contrast, access to Forest Service trails from Cottonwood is concentrated in the northern part of the city. To the southwest of Cottonwood, the U.S. Forest Service provides a good number of trails and trailheads, but few trails are connected despite their close proximity. Further, access to the trails is not provided through neighboring cities that, if completed, could potentially increase the recreational benefits of the residents as well as tourists.

This inventory can aid communities in planning for trail interconnectivity, especially in connecting towns and cities to existing amenities on Federal lands (in this case, the Prescott and Coconino National Forests). Additionally, the inventory can be used to help communities prioritize acquisition and trail construction while creating partnerships to leverage limited funds.

Figure 25. Existing and Potential Future Non-motorized Trails and Access Points in the Verde Valley Area

Existing and Potential Future Non-Motorized Trails and Access Points in the Verde Valley Area

Urban Amenities as Trail Destinations
A similar example can be seen in urban areas, such as Phoenix. As communities promote smart growth practices such as creating sense of place and providing for pedestrian movement to and from neighborhood amenities, they need to analyze what trail connections are missing to provide safe and enjoyable access to a "pedestrian freeway".

Figure 26 shows urban trails in the vicinity of Cactus Road and Tatum Boulevard. Here, the mall may be considered a neighborhood amenity and is located near many homes. Yet pedestrian access by designated trails south of the mall is limited because no trails provide access across the golf course or link the existing off-street urban trail (in solid pink on the map) to the planned roadside trail (in dotted blue) that encircles the mall.

While it may be possible to walk along existing sidewalks not designated as trails in urban areas, promoting designated and connected trails can increase their use by residents and promote concepts of smart growth. Further, urban trails can help create a sense of place for local neighborhoods (for example, the Murphy Bridle Path along Central Avenue in Phoenix).

Figure 26. Existing and Potential Future Non-motorized Trails and Access Points in the Paradise Valley Mall Area

Existing and Potential Future Non-Motorized Trails in the Paradise Valley Mall Area
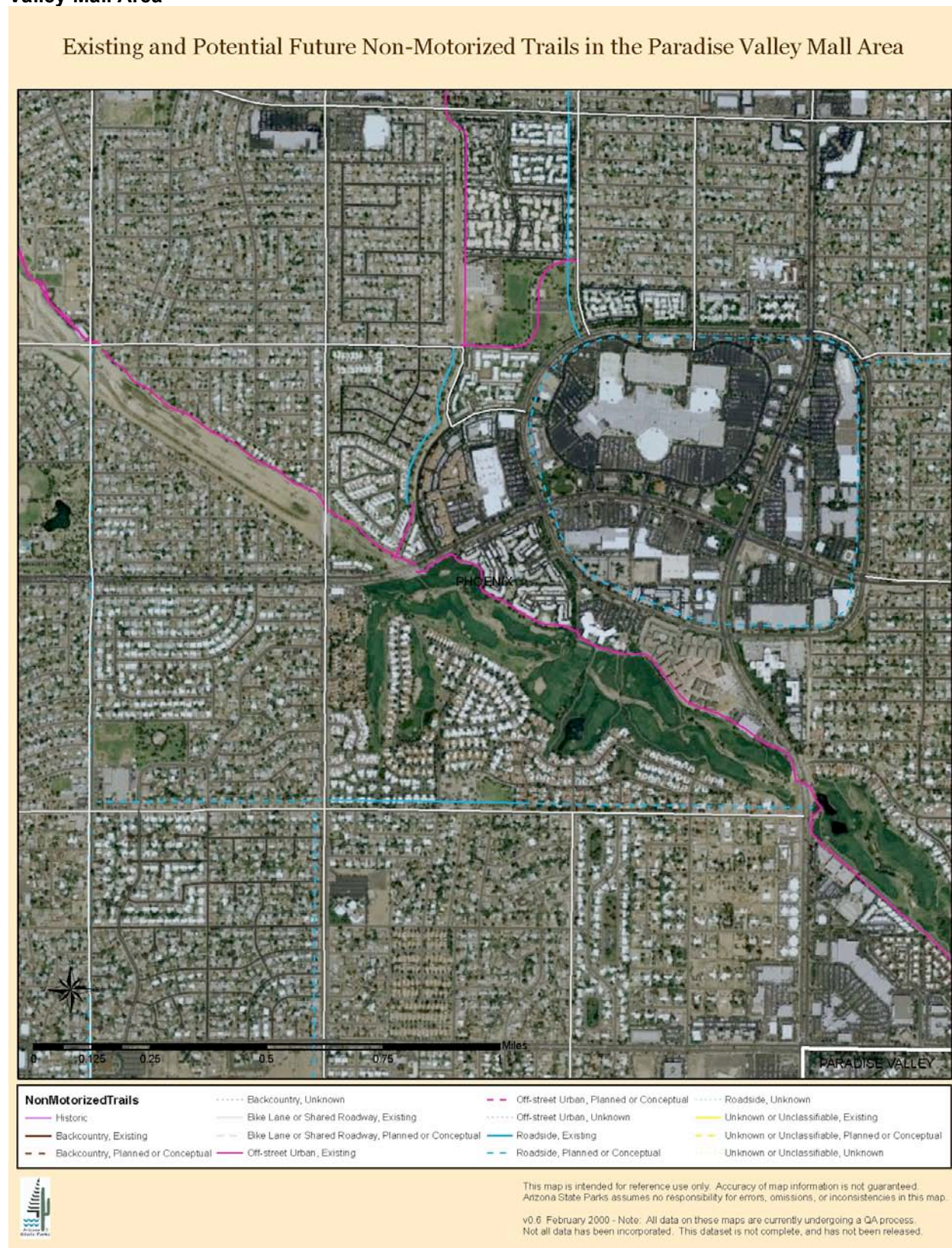
Hot Spots for Future Trail Development
The Open Space and Recreation Inventory can also be used to look at "hot spots" of future trail development. For example, the Central Arizona Association of Governments estimates that Pinal County's population increased 77% from 2000 to 2007 with the most growth occurring in unincorporated communities such as San Tan, followed by Casa Grande, Apache Junction, and Maricopa. While many types of trails currently exist in Maricopa and Pima Counties, few trails exist in Pinal County, the growing center of the Sun Corridor (see Figure 27).

The database illustrates the relatively few miles of existing trails and highlights the importance of planned trails to accommodate the area's future population growth. In light of slow economic times and limited available funding for acquiring and building trails, local jurisdictions could potentially work together on prioritizing routes for development. The trails database could be overlain with Pinal County Planned Area Development layers to better understand how development patterns impact trails and access and plan for improved amenities as development occurs in the future.

Additionally, because the database now allows a more regional view of trail locations and access points, communities could broaden partnerships to include jurisdictions beyond their immediate borders. This is especially important due to the increasing population in large unincorporated developments.

Figure 27. Sample of High Growth, High Need Area: Pinal County
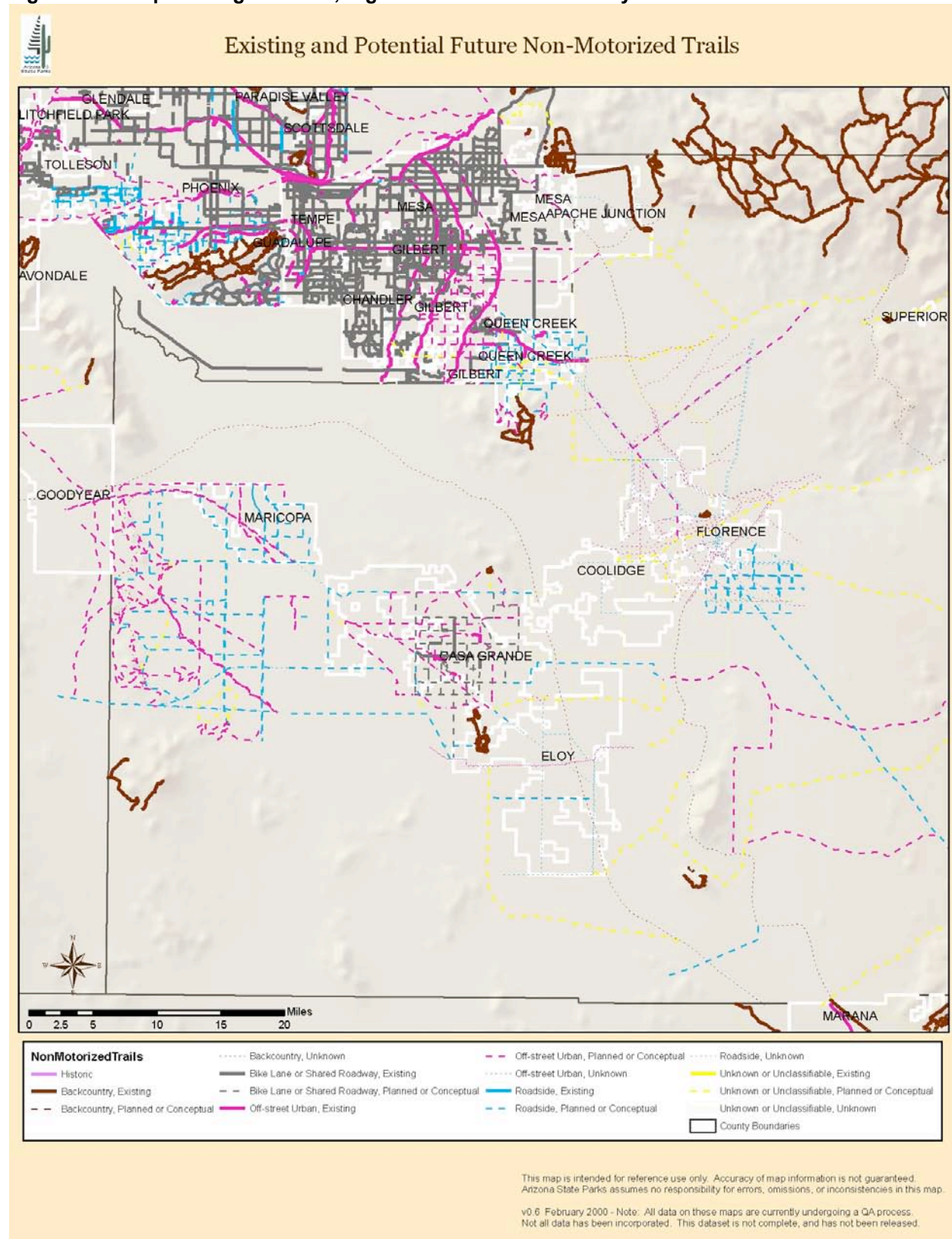
It has been said "the best data won't make any difference unless you can communicate it well to a large audience". The open space and recreation inventory will be made available in geodatabase and shapefile format through the Arizona Geographic Council's Geodata Portal. Additionally, future work includes coordination with national efforts such as the U.S. Protected Areas Database.

In order to make the data available to an even wider audience, including trail users, the inventory team has also begun development of an online map application that will allow users to view and query the inventories, and download data in a variety of formats, including Google Earth kml. By making the open space and recreation inventory publicly available, it enables other researchers to use the data as well. Although the data has not been publicly released yet, researchers from Arizona State University are already using the parks inventory in a project that will evaluate the economic value of parkland. Other researchers from Arizona State University are using the trails inventory for a multi-modal transportation study. Valley Forward is also using the trails inventory in their Pedestrian Freeway plan. The team expects use of the data to continue to increase, once it is publicly released.

Alternative Transportation
Portions contributed by Michael Sanders, Senior Planner, Arizona Department of Transportation

Alternative transportation promotes and encourages the use of alternative modes of transportation (e.g. bicycling, walking, vanpooling, carpooling, riding transit) to get to, from, and around a community instead of a single occupancy vehicle. While both alternative transportation routes and recreational trails utilize linear pathways, their goals are different which affects their design and location. Alternative transportation routes are utilitarian in design and can carry large amounts of pedestrians or bicyclists quickly and to specific destinations; these pathways are frequently adjacent to streets and roadways. Recreational trails are designed for leisurely, and sometimes challenging, travel through natural areas and other scenic locations away from streets and highways.

Photo: Pathways separated but adjacent to streets provide both alternative transportation and recreation opportunities. Photo courtesy of ADOT Transportation Enhancement Program.

Some alternative transportation systems are also used for recreational purposes and sometimes, recreational trails are used as transportation routes. Typically, transportation use is a function of need, where recreational use is a function of leisure.

When initially developed, these systems oftentimes are used primarily for recreation because they may be isolated, do not link to other routes or facilities, or do not provide access to destinations. As connections are made and urbanization and development occur along or near an alternative transportation route, the system may take on a new role – less recreation, more transportation.

Benefits of Alternative Transportation Systems
The benefits of alternative transportation are numerous: they enhance connectivity of people and places, healthier lifestyles, economics, tourism, local heritage. The U.S. Department of Transportation, Federal Highway Administration is an advocate and promoter of alternative transportation and its related benefits (Transportation Enhancement Grant Program, Chapter 6).

Alternative transportation serves as a critical link throughout the overall transportation network, providing pedestrian and bicycle access to home, work, education, commerce, transit, and recreation. Because alternative transportation systems provide such fundamental services to the public, they should be designed to meet the needs of the maximum number of potential user groups. People with disabilities who live in areas without accessible alternative transportation networks and do not have access to automobiles face a greater risk of becoming isolated from the community and unnecessarily dependent upon others to perform routine activities such as grocery shopping. An all inclusive approach to alternative transportation facility design will ensure that the needs of all potential users are addressed, including people with disabilities.

Alternative transportation systems can enrich the livability of a community; they provide opportunity for a population that does not have, or chooses not to have, access to a vehicle. Commercial districts with alternative transportation access will have a larger customer base.

In addition, all people will be able to participate more easily in the community if a system is available because they can reach their desired destinations more easily.

Photo: Paved pathways and pedestrian overpasses facilitate using and crossing busy streets for people of all abilities.

Neighborhoods that incorporate and are connected to an alternative transportation system, that encourage walking, biking or horseback riding, become safer because there are more people on the street. By including a range of opportunities such as bike lanes, separated walkways and bridle paths, and designating canal right of ways for trail use, transportation planners can enhance a community's image. A broader range of consumer, social, and recreational opportunities is available in areas that connect to an alternative transportation network.

Use of inclusive transportation systems is a Smart Growth strategy. The concept encourages creativity, interest, and variety and builds upon local heritage and character to create efficient, sustainable and livable places. These systems encourage less dependence on the personal automobile and allow a community to grow in an economically, environmentally, and socially responsible way, where reliance on non-renewable resources is limited. Progressive communities are realizing the way to alleviate congestion and gridlock is not to build more roads, but to reduce the number of vehicles on the street by using alternative forms of transportation, in particular for short trips.

Greenways can be considered key components in any alternative transportation system. Greenways are linear open space not associated with a vehicular roadway used to create a network that connects parks and natural areas. Typically greenways are located along creeks, streams, river, or utility corridors and are managed as natural environments. Both recreation and transportation uses can be accommodated within greenway corridors. As the network becomes more complete, recreational uses often transition to transportation uses.

Photo: Greenways and river parks not only add beauty and open space to a city, they offer trails for transportation and recreation (Tucson).

(*www.co.monroe.in.us/planning/documents/MCATGSP-SystemPlan.pdf*)

The Arizona Department of Transportation oversees the state's efforts concerning alternative transportation. The Department is guided the Arizona State Transportation Board.

Arizona State Transportation Board Policy: Bicycle and Pedestrian Facilities
It is the policy of the Arizona State Transportation Board (http://www.dot.state.az.us/Board/PDF/Board_Policies_081503.pdf) to encourage bicycling and walking as viable transportation modes, and actively work toward improving the transportation network so that these modes are accommodated, by:

- Promoting increased use of bicycling and walking, and accommodating bicycle and pedestrian needs in the planning, design and construction of transportation facilities alongside state highways.
- Developing design guidelines and measures that give the roadway designer flexibility in accommodating the needs of all users of the transportation facility.
- Developing design guideline implementation policies that balance the needs of motorists, bicyclists and pedestrians.
- Pursuing the use of Federal funds that are available for alternative modes.

Arizona Department of Transportation (ADOT): Statewide Bicycle and Pedestrian Plan
Bicycling and walking are basic, fundamental modes of transportation that, in today's motorized world of travel, are commonly overlooked as an option to help manage our circulation issues and concerns. One of the underlying principles in planning for bicycling and walking is to provide a system that allows users significant mode choices and that creates a reasonable balance in accommodating those choices, without favoring one mode at the expense of all others. To achieve a balance within the current transportation network, bicycling and walking need to be made more attractive and truly be a viable option for transportation. This includes creating a non-motorized network comprised of on-street facilities, off-street facilities, and end-of-trip facilities. Education and enforcement programs enhance alternative forms of transportation.

Arizona Bicycle Network
The Arizona Bicycle Network is comprised of roadways within the State Highway System and it includes regionally significant non-ADOT bicycle facilities. The combination of non-ADOT bicycle and pedestrian facilities with the State Highway System creates a network that complements itself. The network has bikeways on highways that connect the communities and then bikeways on streets and roads within the communities. The existing Arizona Bicycle Network is displayed on the *Cycle Arizona Bicycle User Map*. The map provides information on shoulder width, grade, and traffic volume designation for state highways so that users can make a

decision regarding the suitability of the route for their use
(http://www.azbikeped.org/images/map%20side%201%20(3-03-06).pdf). The map also provides
the local bicycle routes with regional significance
(http://www.azbikeped.org/images/map%20side%202%20(3-03-06).pdf), points of public
interest, monthly statewide average temperature, annual bicycle events, safety tips, Arizona
bicycle safety laws, and other bicycle resources. Inset maps are provided for Flagstaff, Phoenix,
Prescott, Tucson, and Yuma.

Photo: The AZ Bicycle Network includes roadways within the State Highway System. ADOT publishes a Cycle AZ Bicycle User Map.
Photo from Dan Cameli and www.pactour.com

Pedestrian Action Plan
Sidewalks should be provided along State Highways where there are origins and destinations in
close proximity. Within close proximity is defined as an origin and a destination within 1.5 miles
walking distance from one another and the subject facility is between the origin and destination.
A transit stop is considered a destination.

The minimum clear width for comfortable walking is five feet. Sidewalks should almost always
be placed on both sides of a highway. Exceptions could include commercial strips entirely on
one side with absolutely no destinations on the other side (e.g. railroad tracks). In most instances,
placing a sidewalk on one side only leads to pedestrians walking on the roadway without a
sidewalk, or crossing the highway twice to access the sidewalks.

It is the policy of the State of Arizona to comply with pedestrian and accessibility requirements
set forth within the 1990 Americans with Disabilities Act (ADA). These scoping and technical
requirements are to be applied during the design, construction, and alteration of transportation
facilities covered by Titles II and III of the ADA to the extent required by regulations issued by
Federal agencies, including the Department of Justice and the Department of Transportation,
under the ADA.

Action 1: Make walkways an integral part of the circulation pattern within communities to
promote safe interactions between motor vehicles and pedestrians and bicyclists, using
techniques such as:
    Strategy 1A. Integrate pedestrian facility accommodation into all planning, design and major
    construction activities of ADOT where there are origins and destinations within close
    proximity of the subject facility.

Strategy 1B. Retrofit existing roadways with sidewalks and retrofit crossings to accommodate pedestrians as a component of major reconstruction where there are origins and destinations within close proximity

Strategy 1C. Provide financial and technical assistance to local governments for construction of walkway projects.

Action 2: Develop education programs that improve pedestrian safety.

Strategy 2A. Monitor and analyze pedestrian crash data to formulate ways to improve pedestrian safety.

Strategy 2B. Assist with the publication of walking maps and guides that inform the public of pedestrian facilities and services.

Strategy 2C. Develop walking safety education programs to improve skills and observance of traffic laws, and promote overall safety for pedestrians.

Strategy 2D. Develop safety education programs aimed at motor vehicle drivers to improve awareness of the needs and rights of pedestrians.

Strategy 2E. Develop a promotional program and materials to encourage increased walking.

Implementation

1. Accommodation of bicyclists and pedestrians on major ADOT roadway projects:
   - Provide bicycle and pedestrian facilities as an integral component of all future projects, with the exception of projects that have no relation to bicyclists or pedestrians
   - Develop a tracking system that provides the State Bicycle and Pedestrian Coordinator, and bicycle and pedestrian advocates throughout the state, with a listing of all major roadway projects including a summary of the bicycle and pedestrian issues and how these issues are being addressed
   - Review, and update as necessary, existing ADOT policies so that bicyclists and pedestrians will be better accommodated on ADOT facilities

2. Development of programs to improve bicycling and walking:
   - Provide planning and design training of bicycle and pedestrian accommodations to other ADOT staff, MPOs, and local governments staff
   - Assist in the development of state, regional, and local bicycle maps
   - Develop pedestrian and bicycle education programs for communities and schools
   - Develop enforcement strategies and programs aimed at bicyclist and pedestrian law violations that are most likely to result in serious crashes
   - Develop enforcement strategies aimed at motorist errors and aggressive behaviors
   - Consider additions to driver's education products that emphasize safe motorist driving when encountering bicyclists and pedestrians on the road
   - Assist in promoting bike-to-work days and safe routes to school programs, and
   - Promote the link between land use and transportation by encouraging smart growth initiatives.

3. Construction of non-ADOT bicycle facilities to fill gaps between the State Highway System and between neighboring jurisdictions:

- Provide a bicycle route into Phoenix that connects SR 88 and SR 79 to the east of Phoenix with other non-ADOT bicycle facilities
- Local government agencies in the metro areas should put a high priority on implementing the regionally significant proposed bicycle facilities
- Bicycle route continuity between adjacent local jurisdictions should be improved

4. Development of bicycle and pedestrian specific projects:

- Construction of off-road shared-use paths:
  - At crossings of ADOT State Highways
  - As access through grade-separated interchanges
- Retrofit of through roadway cattle guards that have gaps greater than one quarter-inch by four inches parallel to the direction of travel; and
- Widening of shoulders that have an effective width of two feet or less with priority being placed on those facilities that can be implemented at a minor or moderate expense and that are adjacent to an urban areas.

Photo: Digital highways signs can be used to provide up to date information to motorists when sharing the road with groups of cyclists. Photo courtesy of Richard C. Moeur.

United States—Mexico Border Issues

The 377 mile Arizona-Sonora border is a portion of one of the world's busiest international boundaries, and as such, an overwhelming number of cross-border illegal and legal activities occur there daily. The border region includes 100 kilometers north and south of the geopolitical divide between the United States and Mexico. The border region has a population of approximately three million people and it continues to grow exponentially as compared to the national average of both the U.S. and Mexico. (HSA 2008)

Arizona contains remote and isolated lands along the Mexican border that have become major arteries for smuggling humans and controlled substances into the United States. As a result, direct and indirect impacts caused by this large amount of illegal traffic have caused a significant adverse impact to fish and wildlife resources and their habitats. (AZGFD 2005)

It is estimated that thousands of new trails have been created on federal lands in southeastern Arizona by undocumented alien crossings. The proliferation of trails and roads damages and destroys sensitive vegetation, disrupts or prohibits re-vegetation, disturbs wildlife and their travel corridors, causes soil compaction and erosion, and impacts stream bank stability. (AZGFD 2005)

Illegal border activities, including alien border crossings and drug smuggling, on federal and tribal lands in Arizona have been increasing since the mid to late 1990s, creating law enforcement challenges for land and resource management agencies. In some cases, smugglers are escorted across federal lands by heavily armed scouts who are equipped with automatic assault weapons, encrypted radios, and night vision optics. This situation poses dangers to law enforcement officers, visitors and employees, and damages fragile natural resources. Due to potential dangers, land management agencies require their law enforcement officers to wear bulletproof vests and carry assault weapons while on duty (GAO 2004).

Incidents reported on federal borderlands in Arizona include break-ins at employees' homes, visitor carjacking, assaults and robberies. Employees and visitors have been forced off the road by smugglers traveling at high rates of speed. Certain federal lands can no longer be used safely by the public or federal employees, according to a 2002 report on the impacts of undocumented aliens crossing federal lands in Arizona, due to the significance of smuggling illegal aliens and controlled substances in the U.S. (GAO 2004)

For example, a portion of the San Pedro River National Conservation Area was closed to overnight camping due to border safety issues and intensive law enforcement activity. The San Rafael Ranch State Natural Area, acquired in 1999 by Arizona State Parks, is not open to the public and one of the main reasons is concern for public safety due to illegal border crossings through the park by human and drug smugglers. Federal agencies managing lands along the border are hesitant to build new trails or officially designate OHV routes because of safety concerns.

The damage is obvious in terms of residual litter, abandoned vehicles and violence associated with alien and narcotic smuggling. In the last five years, Yuma sector agents have arrested over 420,000 illegal aliens. In 2006, Yuma sector agents apprehended over 98,000. Anytime such large numbers of people transit an area of this size, whether it be on foot, by vehicle across the

open deserts or by crossing the Colorado River, there will be a significant impact on the natural resources of the area, the ability of citizens to recreate, and the overall safety of the area. (AZGFD 2005)

Apprehensions data is a fairly unreliable gauge of how many people are attempting to enter the country illegally. The data is valuable, however, in that it provides a glimpse at the trends on the ground along the border. Overall, Arizona accounted for 51% of all apprehensions along the southwest border in FY04 and for 76% of the overall national increase in apprehensions between FY03 and FY04. (CRS 2005)

Illegal border activity is affecting federal lands beyond those immediately along the border and creating law enforcement challenges there. For example, Ironwood Forest National Monument sits more than 60 miles north of the Mexican border, yet BLM officials indicated it shares many of the border related problems of federal lands right on the border. BLM indicated that as a result of one officer
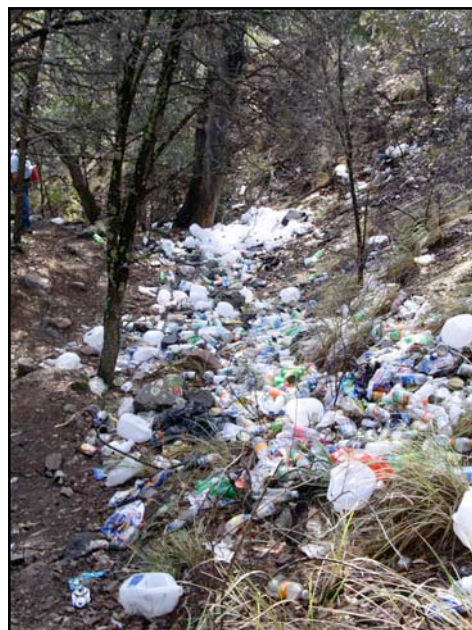

Photo: Trash left by illegal immigrants, Scotia Canyon, Coronado National Forest. Photo courtesy of John E. Roberts (this area was once identified as one of AZ's top 75 natural areas)

being nearly run over by illegal aliens in vehicles, as well as assaults on officers, the Bureau requires that officers travel in patrol teams to help ensure their safety. The Ironwood's vulnerable ecosystem, with over 600 animal and plant species – some of them endangered – have been damaged by illegal border traffic. According to Bureau officials, smugglers and other illegal aliens have established more than 50 illegal roads through the monument that damage plants. In addition, illegal aliens and smugglers abandon about 600 vehicles each year and leave behind tons of waste that creates biohazards (GAO 2004).

Border Patrol enforcement activities also create environmental impacts when large swaths of land are bladed smooth to facilitate tracking of illegal crossings into the state or from rescues of illegal immigrants who have lost their way or run out of food and water.

Table 56. Land Managers' Perception of Border Impacts
(from human and drug smuggling activities such as trespass, safety/security, litter and resource damage along trails)

Perceptions of Border Impacts	% Not a Problem		% Slight Problem		% Moderate Problem		% Serious Problem	
	Non Motor	Motor	Non Motor	Motor	Non Motor	Motor	Non Motor	Motor
State Agencies	40.0	21.1	20.0	21.1	12.0	15.8	28.0	42.1
Federal Agencies	26.2	24.0	18.0	14.0	24.6	24.0	31.1	38.0
Cities/Counties	52.2	40.0	28.3	15.0	10.9	25.0	8.7	20.0